

Shaktoolik River Salmon Counting Tower  
Project Summary Report, 1996

by

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## **INTRODUCTION**

The Shaktoolik River flows southwest approximately 95 miles from it's source in the Nulato Hills to Shaktoolik Bay. The Shaktoolik River is the major salmon producing stream in the Shaktoolik subdistrict of Norton Sound. The village of Shaktoolik is located near the mouth of the river. The Shaktoolik River supports both subsistence and sport fisheries.

The project is operated by the Alaska Department of Fish & Game (ADF&G) to obtain more timely and accurate escapement information required for the active management of salmon stocks throughout the season. This was the first year of counting tower operation that has produced usable data. Previous attempts by other agencies to operate a counting tower project on the Shaktoolik River have been unsuccessful (Charles Lean, ADF&G, personal communication).

## **OBJECTIVES**

1. Obtain daily and seasonal estimates of the timing and magnitude of the salmon escapement, by species, to the Shaktoolik River.
2. Obtain daily and seasonal estimates of the timing and magnitude of the Dolly Varden escapement to the Shaktoolik River.

## **METHODS**

The Shaktoolik River tower camp is located approximately 5 miles upstream from the village of Shaktoolik (Figure 1). A letter of understanding from the Shaktoolik Native Corporation authorizes the tower operation on Corporation lands.

Equipment, materials and supplies for the project were assembled in Nome and the village of Unalakleet. The two boats for the project were towed to Shaktoolik from Unalakleet and the remaining items were then flown to Shaktoolik beginning on 4 June, 1996, when the two member crew began work. They, along with Nome office staff, began moving equipment upriver to the tower site. Two tent frames were built and the rest of the camp established. Two counting towers were erected, one on each side of the river. A flash panel was deployed across the entire river. To ensure that the counts made from each tower only counted the nearest half of the river, a section of panel was deployed vertically in the middle of the river to divide the river into half.

A 120 volt lighting system was installed to illuminate the flash panel during dark periods. These lights were powered by a portable generator.

The ADF&G, Commercial Fisheries Management and Development Division (CFM&D Division) provided operational funding for the Shaktoolik River counting tower. Counts began on 17 June and ended on 24 July, 1996. The counting schedule was 16 hourly shifts each day from 1300 hours to 0400 hours the following day; during each hourly shift the crew counted a twenty minute shift on each side of the river. A 24 hour count and a day off were scheduled weekly. The two twenty minute counts from each hour were added together to give a subtotal total for each species. These subtotals were tripled to produce the reported hourly total for each species. Each day the reported hourly totals were added to produce an unexpanded daily total for each species. Every day the daily and cumulative unexpanded totals for each species were relayed to the Nome office by radio and telephone via the Unalakleet office.

The expanded counts for this report were calculated using the following methods. The 16 hour counts for days off were estimated by adding the counts of each hour of the day before to the counts of each hour of the day following and dividing the result by two, giving hourly counts for 16 hours of the day off. Next an expansion factor was calculated to expand for the 8 hours not normally counted. This factor was derived from the weekly 24 hour count by dividing the total count from 0500 hours to 1200 hours during the 24 hour count day by the total normal 16 hour count during the 24 hour count day. Then each 16 hour count for the remaining days was expanded to 24 hour counts by applying the expansion factor from the nearest 24 hour count day and multiplying each day's 16 hour total by the 24 hour expansion factor, and adding that number to the 16 hour count for each day. This expansion was done for all species counted.

The expanded counts for the days missed because of high water and weir washout were linearly interpolated as follows. For a day with the normal 16 hour count missed, the count for the missing day was calculated by adding the counts of each hour of the day before the missed period to the counts of each hour of the day following the missed period and dividing the result by two. When two normal 16 hour count days were missed, the count for the two missing days was calculated by adding the counts of each hour of the day before the missed period to the counts of each hour of the day following the missed period and dividing the result by two. When three such days were missed, the count for the middle missing day was calculated by adding the counts of each hour of the day before the missed period to the counts of each hour of the day following the missed period and dividing the result by two; the count for the first missing day was calculated by adding the counts of each hour of the day before the missed period to the calculated counts of each hour of the middle missing day and dividing the result by two; the count for the third missing day was calculated by adding the counts of each hour of the day following the missed period to the counts of each hour of the calculated missing day and dividing the result by two. Then each 16 hour count was expanded to a 24 hour count by multiplying each days 16 hour total by the nearest 24 hour expansion factor, and adding that number to the 16 hour count for each day.



## RESULTS

Table 1 shows the expanded daily and cumulative totals for each species.

The reported net upstream total hourly counts were: 28,404 chum salmon, 418,221 pink salmon, 1,368 king salmon, 1,143 coho salmon, and 12 Dolly Varden. Tables 7-11 show the hourly counts of each species. The expanded counts were: 44,840 chum salmon, 625,155 pink salmon, 1,886 king salmon, 1,585 coho salmon, and -54 Dolly Varden. Tables 2-6 show the expanded hourly counts of each species. Figure 2 shows a graph of the daily cumulative expanded passage of all salmon species, except pink salmon, counted. Figures 3-12 show graphs of the expanded daily totals and the cumulative daily totals for each species.

Chum, pink and king salmon and Dolly Varden were observed on 17 June, the first day of counting. Coho salmon were first observed on 16 July (Table 1). The daily peak count of 12,903 chum salmon occurred on 8 July, the daily peak count of 143,896 pink salmon occurred on 10 July, the daily peak count of 300 king salmon occurred on 1 July, the daily peak count of 472 coho salmon occurred on 23 July, the daily peak upstream count of 18 Dolly Varden occurred on 18 June and the daily peak downstream count of -24 Dolly Varden occurred on 15 July (Table 1).

Most chum salmon returned during the period from 3 July through 8 July when 64% passed the tower (Table 1 and Figures 3 and 4). Most pink salmon returned during the period from 5 July through 11 July when 68% passed the tower (Table 1 and Figures 5 and 6). Most king salmon returned during the period from 20 June through 10 July when 97% passed the tower (Table 1 and Figures 7 and 8). Only the first nine days of the coho salmon escapement were observed before the counting tower ceased operation for the season (Table 1 and Figures 9 and 10). The most Dolly Varden passed the counting tower during the six day period from 11 July to 16 July when 92 fish migrated downstream (Table 1 and Figures 11 and 12).

All species counted exhibited a diurnal pattern of migration past the counting tower. The greatest hourly chum salmon migration occurred during the hour from 2200 to 2300, when 19.4% passed the tower. During the seven hour period from 1900 through 0100 hours, 74% of the chum salmon passed the tower (Table 2 and Figure 13). The greatest hourly pink salmon migration occurred during the hour from 2000 to 2100 hours, when 19% passed the tower. During the seven hour period from 1800 through 0000 hours, 83% of the pink salmon passed the tower (Table 3 and Figure 14). The greatest hourly king salmon migration occurred during the hour from 1600 to 1700, when 9.7% passed the tower. During the twelve hour period from 1300 through 0000 hours, 80% of the king salmon passed the tower (Table 4 and Figure 15). The greatest hourly coho salmon migration occurred during the hour from 2300 to 0000 hours, when 16.7% passed the tower. During the seven hour period from 1800 through 0000 hours 69% of the coho salmon passed the tower (Table 5 and Figure 16). The greatest hourly upstream Dolly Varden migration occurred during the hour from 0000 to 0100, when 20 fish passed the

tower. The greatest hourly downstream Dolly Varden Migration occurred during the hour from 1300 to 1400 hours when 23 fish passed the tower (Table 6 and Figure 17).

An aerial survey of the Shaktoolik River counted 7,337 chum salmon on 16 July, 1996. The total season expanded tower count of chum salmon was 44,840. The aerial survey counted 16% of the total season expanded tower count of chum salmon. The aerial survey counted 7,307 chum salmon above the counting tower on 16 July, when the cumulative tower count of chum salmon was 39,382. The aerial survey counted 19% of the cumulative tower count of chum salmon on 16 July (Table 1). An aerial survey count of 150,310 pink salmon was made on 16 July, 1996. The total season expanded tower count of pink salmon was 625,155. The aerial survey counted 24% of the total season expanded tower count of pink salmon. The aerial survey counted 139,310 pink salmon above the counting tower on 16 July, when the cumulative tower count of pink salmon was 471,557. The aerial survey counted 30% of the cumulative tower count of pink salmon on 9 July (Table 1). An aerial survey count of 206 king salmon was made on 16 July, 1996. The total season expanded tower count of king salmon was 1,886. The aerial survey counted 11% of the total season expanded tower count of king salmon. The aerial survey counted 206 king salmon above the counting tower on 16 July, when the cumulative tower count of king salmon was 1,884. The aerial survey counted 11% of the cumulative tower count of king salmon on 9 July (Table 1). An aerial survey count of 3,821 coho salmon was made on 27 August, 1996, which was well after the tower project was concluded on 24 July, making comparison of the two data sources inappropriate.

Climatological and stream observations are shown in Table 12.

## **DISCUSSION**

A counting tower project that focused on counting coho salmon was conducted by the U.S. Bureau of Land Management on the Shaktoolik River in the early 1990's. That project was washed out by flooding and no useable data was collected (Charles Lean, ADF&G, personal communication).

Counting began on 17 June in 1996. During initial camp set up from 4 - 8 June, 1996, chum, pink, king salmon and Dolly Varden were observed passing the tower site. In the future the tower should be operational by 6 June to serve as a useful management tool by counting the early portion of the king salmon escapement. The tower should also operate through August to count most of the coho salmon escapement.

Major difficulties were encountered this year. In early June while the camp was being established the river levels were dropping and the turbid water was clearing. Then rain on 7 and 8 June raised the water levels and the water quality changed, becoming extremely tannic. The water remained tannic throughout the season, making fish observation difficult. During initial set up, the towers and flash panel were installed when the river bottom was not visible. When water levels and visibility improved

enough to see the panel, it became apparent that much of it was not resting on the river bottom. The towers and panel were moved downstream about 100 feet to a slightly shallower location. It was not until several days after counting began that the flash panel was completely on the bottom at this new location. Throughout June and July, there was enough rain to keep water levels high and visibility poor because of tannic stain. The project was terminated and the equipment dismantled and stored during the week of 5 August after a sustained period of high water beginning on 25 July.

A trip was made to the Shaktoolik River in early September, 1996 to look for alternative tower sites. It was determined that the best option is approximately 100 feet downstream from the second site used in 1996.

The high levels of tannins in the water during the summer of 1996 appears to be an anomaly. Local opinion indicates that this was unusual.

#### **ACKNOWLEDGEMENTS**

The crew members for the entire season were David Bonila and Myron Savetilik. A draft of this report was reviewed by Larry Buklis.

Table 1. Expanded daily and cumulative migration of all salmonid species past the Shaktoolik River counting tower, Norton Sound, 1996.

Date	Daily chum salmon	Cumulative chum salmon	Daily pink salmon	Cumulative pink salmon	Daily king salmon	Cumulative king salmon	Daily coho salmon	Cumulative coho salmon	Daily Dolly Varden	Cumulative Dolly Varden
17-Jun	9	9	-3	-3	3	3	0	0	-3	-3
18-Jun	16	25	51	48	0	3	0	0	18	15
19-Jun	24	49	61	109	19	22	0	0	6	21
20-Jun	118	167	3	112	297	319	0	0	3	24
21-Jun	219	386	91	203	103	422	0	0	6	30
22-Jun	69	455	24	227	3	425	0	0	-6	24
23-Jun	253	708	189	416	14	439	0	0	-9	15
24-Jun	491	1,199	350	766	117	556	0	0	-9	6
25-Jun	654	1,853	469	1,235	29	585	0	0	6	12
26-Jun	207	2,060	105	1,340	3	588	0	0	0	12
27-Jun	355	2,415	246	1,586	12	600	0	0	0	12
28-Jun	445	2,860	272	1,858	13	613	0	0	0	12
29-Jun	516	3,376	516	2,374	26	639	0	0	-3	9
30-Jun	429	3,805	450	2,824	166	805	0	0	-2	7
1-Jul	333	4,138	378	3,202	300	1,105	0	0	9	16
2-Jul	516	4,654	989	4,191	100	1,205	0	0	3	19
3-Jul	2,997	7,651	3,119	7,310	113	1,318	0	0	6	25
4-Jul	2,466	10,117	5,390	12,700	95	1,413	0	0	2	27
5-Jul	1,433	11,550	7,016	19,716	78	1,491	0	0	-3	24
6-Jul	1,557	13,107	22,115	41,831	118	1,609	0	0	0	24
7-Jul	7,234	20,341	51,996	93,827	85	1,694	0	0	4	28
8-Jul	12,903	33,244	81,870	175,697	48	1,742	0	0	6	34
9-Jul	686	33,930	45,020	220,717	52	1,794	0	0	0	34
10-Jul	1,614	35,544	143,896	364,613	59	1,853	0	0	0	34
11-Jul	819	36,363	72,211	436,824	28	1,881	0	0	-6	28
12-Jul	26	36,389	908	437,732	-2	1,879	0	0	-16	12
13-Jul	90	36,479	1,348	439,080	-1	1,878	0	0	-18	-6
14-Jul	724	37,203	7,747	446,827	1	1,879	0	0	-22	-28
15-Jul	1,347	38,550	14,136	460,963	3	1,882	0	0	-24	-52
16-Jul	832	39,382	10,594	471,557	2	1,884	21	21	-6	-58
17-Jul	367	39,749	7,871	479,428	1	1,885	50	71	0	-58
18-Jul	573	40,322	14,730	494,158	1	1,886	114	185	0	-58
19-Jul	781	41,103	22,867	517,025	0	1,886	186	371	0	-58
20-Jul	809	41,912	31,152	548,177	0	1,886	136	507	0	-58
21-Jul	850	42,762	28,429	576,606	0	1,886	194	701	1	-57
22-Jul	885	43,647	25,698	602,304	0	1,886	246	947	3	-54
23-Jul	1,089	44,736	19,662	621,966	0	1,886	472	1,419	0	-54
24-Jul	104	44,840	3,189	625,155	0	1,886	166	1,585	0	-54

Table 2. Expanded daily hourly chum salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.

Shaded areas indicate hours not counted. Numbers in shaded areas indicate estimated passage.

Date	0000	0100	0200	0300	0400	0500-1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun							0	3	0	0	0	0	0	3	3	0	0	9	0.0%
18-Jun	3	0	0	6	3	4	0	0	0	0	0	0	0	0	0	0	0	16	0.0%
19-Jun	0	0	0	0	0	6	0	9	0	0	0	3	0	-9	18	3	-6	24	0.1%
20-Jun	3	12	3	-3	9	31	-3	-3	0	0	3	3	3	33	12	3	12	118	0.3%
21-Jun	15	9	0	3	3	57	0	27	9	9	15	3	30	0	9	3	27	219	0.5%
22-Jun	9	12	3	15	3	18	0	0	0	0	0	0	0	0	6	0	3	69	0.2%
23-Jun	21	29	6	14	27	66	0	5	2	2	26	0	-2	26	6	8	17	253	0.6%
24-Jun	33	45	9	12	51	177	0	9	2	3	51	0	-3	51	6	15	30	491	1.1%
25-Jun	27	36	6	0	33	171	0	21	3	69	36	42	18	63	96	27	6	654	1.5%
26-Jun	36	24	81	12	0	54	0	0	0	0	0	0	0	0	0	0	0	207	0.5%
27-Jun	18	21	48	56	38	93	6	5	-6	8	62	3	0	0	5	-2	0	355	0.8%
28-Jun	18	21	48	56	38	116	6	5	-6	8	123	6	0	0	9	-3	0	445	1.0%
29-Jun	0	18	15	99	75	135	12	9	-12	15	21	15	21	6	72	15	0	516	1.2%
30-Jun	8	12	2	53	36	112	11	6	-6	12	51	6	15	14	60	26	11	429	1.0%
1-Jul	15	6	-12	6	-3	87	9	3	0	9	81	-3	9	21	48	36	21	333	0.7%
2-Jul	3	18	6	21	24	135	-3	27	9	6	6	9	24	36		63	132	516	1.2%
3-Jul	156	477	330	33	21	783	102	60	21	18	72	81	123	96	222	294	108	2,997	6.7%
4-Jul	222	363	222	33	17	644	68	53	48	17	72	75	68	56	159	242	107	2,466	5.5%
5-Jul	288	249	114	33	12	11	33	45	75	15	72	69	12	15	96	189	105	1,433	3.2%
6-Jul	207	132	42	12	6	12	57	57	30	6	57	114	24	288	72	162	279	1,557	3.5%
7-Jul	198	117	50	6	8	54	80	68	60	21	87	167	149	405	1,547	2,289	1,928	7,234	16.1%
8-Jul	189	102	57	0	9	96	102	78	90	36	117	219	273	522	3,021	4,416	3,576	12,903	28.8%
9-Jul	87	57	48	15	9	5	48	45	24	21	192	36	63	27	3	6	0	686	1.5%
10-Jul	6	-3	0	0	0	12	3	6	36	21	12	165	651	510	150	36	9	1,614	3.6%
11-Jul	3	2	-14	0	5	6	5	3	23	11	6	83	330	257	75	18	6	819	1.8%
12-Jul	3	2	-14	0	5	0	6	0	9	0	0	0	9	3	0	0	3	26	0.1%
13-Jul	0	6	-27	0	9	0	21	6	18	6	3	9	12	18	0	6	3	90	0.2%
14-Jul	65	20	11	14	6	2	12	11	59	65	48	60	86	62	81	87	35	724	1.6%
15-Jul	129	33	48	27	3	3	3	15	99	123	93	111	159	105	162	168	66	1,347	3.0%
16-Jul	112	38	43	23	3	2	21	24	12	68	51	59	86	66	93	92	39	832	1.9%
17-Jul	95	42	38	18	2	1	18	12	24	12	9	6	12	27	24	15	12	367	0.8%
18-Jul	78	47	33	14	1	1	11	8	15	26	59	44	48	80	24	33	51	573	1.3%
19-Jul	60	51	27	9	0	13	3	3	6	39	108	81	84	132	24	51	90	781	1.7%
20-Jul	96	66	3	0	0	14	0	3	15	45	27	75	93	195	126	39	12	809	1.8%
21-Jul	72	47	3	2	2	14	9	3	8	39	23	59	66	107	174	93	129	850	1.9%
22-Jul	48	27	3	3	3	15	18	3	0	33	18	42	39	18	222	147	246	885	2.0%
23-Jul	123	75	18	6	0	18	6	3	0	108	132	168	78	102	39	96	117	1,089	2.4%
24-Jul	18	12	0	6	9	2	0	0	0	3	0	3	0	0	6	18	27	104	0.2%
Total =	2,464	2,225	1,250	604	467	2,970	664	632	667	874	1,733	1,813	2,580	3,335	6,670	8,691	7,201	44,840	
	5.5%	5.0%	2.8%	1.3%	1.0%	6.6%	1.5%	1.4%	1.5%	1.9%	3.9%	4.0%	5.8%	7.4%	14.9%	19.4%	16.1%	100.0%	

Table 3. Expanded daily hourly pink salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.

Shaded areas indicate hours not counted. Numbers in shaded areas indicate estimated passage.

Date	0000	0100	0200	0300	0400	0500-1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun							0	-3	0	0	0	0	0	0	0	-3	3	-3	0.0%
18-Jun	3	6	0	24	9	6	0	0	0	0	0	0	0	0	3	0	0	51	0.0%
19-Jun	3	3	6	3	0	7	0	0	3	0	0	0	3	3	21	9	0	61	0.0%
20-Jun	-3	18	3	6	-15	0	-3	-3	0	0	6	3	0	-6	3	6	-12	3	0.0%
21-Jun	0	6	0	9	-6	10	0	27	9	0	6	0	12	0	-9	3	24	91	0.0%
22-Jun	-9	9	-6	-9	0	3	0	0	0	0	0	0	0	0	24	0	12	24	0.0%
23-Jun	8	11	-2	-5	12	21	3	2	2	6	14	5	3	57	17	17	18	189	0.0%
24-Jun	24	12	3	0	24	42	6	3	2	12	27	9	6	114	9	33	24	350	0.1%
25-Jun	21	81	3	0	6	52	6	45	3	54	33	15	12	30	84	18	6	469	0.1%
26-Jun	21	30	33	0	9	12	0	0	0	0	0	0	0	0	0	0	0	105	0.0%
27-Jun	11	102	30	9	23	27	17	-3	2	0	20	2	2	2	5	-3	0	246	0.0%
28-Jun	11	102	30	9	23	30	17	-3	2	0	39	3	3	3	9	-6	0	272	0.0%
29-Jun	0	174	27	18	36	57	33	-6	3	0	27	3	12	15	96	21	0	516	0.1%
30-Jun	5	86	15	17	26	50	23	-3	6	0	44	-2	9	21	99	36	18	450	0.1%
1-Jul	9	-3	3	15	15	42	12	0	9	0	60	-6	6	27	102	51	36	378	0.1%
2-Jul	12	60	27	27	15	110	3	9	75	96	60	114	51	96		60	174	989	0.2%
3-Jul	255	309	276	18	6	347	90	66	27	87	102	174	384	270	267	225	216	3,119	0.5%
4-Jul	366	378	201	33	17	599	305	309	167	176	143	308	236	171	218	624	1,139	5,390	0.9%
5-Jul	477	447	126	48	27	215	519	552	306	264	183	441	87	72	168	1,023	2,061	7,016	1.1%
6-Jul	2,985	1,632	597	561	537	677	894	393	639	375	321	651	456	3,510	2,046	2,331	3,510	22,115	3.5%
7-Jul	5,208	2,363	1,112	303	414	1,593	507	252	365	206	219	534	1,004	4,584	14,075	10,659	8,598	51,996	8.3%
8-Jul	7,431	3,093	1,626	45	291	2,508	120	111	90	36	117	417	1,551	5,658	26,103	18,987	13,686	81,870	13.1%
9-Jul	5,742	2,979	2,964	987	723	1,379	1,512	1,374	1,083	438	2,298	5,454	5,838	6,612	1,308	3,924	405	45,020	7.2%
10-Jul	420	210	39	6	18	4,408	150	309	1,092	684	627	19,077	61,290	47,175	4,206	2,586	1,599	143,896	23.0%
11-Jul	203	59	8	15	20	2,212	80	171	564	363	335	9,575	30,744	23,648	2,099	1,323	792	72,211	11.6%
12-Jul	203	59	8	15	20	15	9	33	36	42	42	72	198	120	-9	60	-15	908	0.1%
13-Jul	-15	-93	-24	24	21	22	183	159	165	105	126	72	126	252	54	90	81	1,348	0.2%
14-Jul	782	59	78	71	51	125	113	104	219	345	413	656	759	932	1,268	1,190	582	7,747	1.2%
15-Jul	1,578	210	180	117	81	228	42	48	273	585	699	1,239	1,392	1,611	2,481	2,289	1,083	14,136	2.3%
16-Jul	1,455	274	206	132	89	171	87	108	54	495	534	773	860	1,212	1,739	1,545	860	10,594	1.7%
17-Jul	1,331	338	231	147	96	127	96	381	471	405	369	306	327	813	996	801	636	7,871	1.3%
18-Jul	1,207	402	257	162	104	238	125	236	279	324	1,085	1,347	923	4,344	1,040	1,146	1,511	14,730	2.4%
19-Jul	1,083	465	282	177	111	1,836	153	90	87	243	1,800	2,388	1,518	7,875	1,083	1,491	2,385	22,867	3.7%
20-Jul	1,923	1,848	141	36	27	2,229	324	372	756	3,795	1,887	3,927	3,351	5,100	3,558	1,278	600	31,152	5.0%
21-Jul	1,619	1,104	113	30	47	2,034	257	233	510	2,024	1,068	2,123	1,878	2,795	3,324	2,415	6,855	28,429	4.5%
22-Jul	1,314	360	84	24	66	1,839	189	93	264	252	249	318	405	489	3,090	3,552	13,110	25,698	4.1%
23-Jul	1,509	669	294	51	6	1,407	90	78	102	1,191	2,721	3,072	1,554	804	1,827	2,481	1,806	19,662	3.1%
24-Jul	459	204	78	39	6	228	69	108	102	102	126	117	117	96	246	396	696	3,189	0.5%
Total =	37,651	18,066	9,049	3,164	2,955	24,706	6,031	5,645	7,767	12,705	15,800	53,187	115,117	118,505	71,650	60,658	62,499	625,155	
	6.0%	2.9%	1.4%	0.5%	0.5%	4.0%	1.0%	0.9%	1.2%	2.0%	2.5%	8.5%	18.4%	19.0%	11.5%	9.7%	10.0%	100.0%	

Table 4. Expanded daily hourly king salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.

Shaded areas indicate hours not counted. Numbers in shaded areas indicate estimated passage.

Date	0000	0100	0200	0300	0400	0500-1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun							0	0	3	0	0	0	0	0	0	0	0	3	0.2%
18-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
19-Jun	0	0	0	0	0	1	0	0	0	18	0	0	0	0	0	0	0	19	1.0%
20-Jun	0	6	0	0	3	21	9	9	21	51	48	45	36	39	6	0	3	297	15.7%
21-Jun	3	0	0	0	0	7	3	18	24	6	15	9	15	3	0	0	0	103	5.5%
22-Jun	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
23-Jun	2	2	2	0	2	1	0	2	0	3	0	0	0	0	0	0	0	14	0.7%
24-Jun	3	3	0	0	3	99	0	3	0	6	0	0	0	0	0	0	0	117	6.2%
25-Jun	0	3	0	0	0	2	0	3	0	3	-3	3	3	-3	9	6	3	29	1.5%
26-Jun	0	3	3	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
27-Jun	0	2	2	-2	0	1	0	2	5	0	0	0	2	0	0	0	0	12	0.6%
28-Jun	0	2	2	-2	0	1	0	2	5	0	0	0	3	0	0	0	0	13	0.7%
29-Jun	0	0	0	0	0	2	0	3	9	0	0	0	0	0	6	3	3	26	1.4%
30-Jun	0	0	0	0	0	12	9	11	11	18	5	9	11	23	6	39	12	166	8.8%
1-Jul	0	0	0	0	0	21	18	18	12	36	9	18	21	45	6	75	21	300	15.9%
2-Jul	3	3	6	0	0	7	24	12	12	6	6	-15	15	6	6	6	9	100	5.3%
3-Jul	6	24	9	-6	0	8	9	0	15	15	12	9	9	6	0	-3	0	113	6.0%
4-Jul	3	14	8	-3	0	7	5	5	15	8	6	6	11	3	2	2	3	95	5.0%
5-Jul	0	3	6	0	0	15	0	9	15	0	0	3	12	0	3	6	6	78	4.1%
6-Jul	33	3	0	0	0	22	0	6	9	0	6	6	0	0	0	6	27	118	6.3%
7-Jul	23	3	3	0	0	16	0	3	6	0	3	3	8	0	-2	5	14	85	4.5%
8-Jul	12	3	6	0	0	9	0	0	3	0	0	0	15	0	-3	3	0	48	2.5%
9-Jul	3	0	0	0	3	10	3	0	0	3	6	3	6	0	9	3	3	52	2.8%
10-Jul	-3	0	3	-3	0	11	-6	0	0	6	6	0	3	27	9	0	6	59	3.1%
11-Jul	-2	-2	2	-2	0	5	-3	0	0	3	3	0	2	14	5	0	3	28	1.5%
12-Jul	-2	-2	2	-2	0	2	0	0	0	0	0	0	0	0	0	0	0	-2	-0.1%
13-Jul	0	-3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	-1	-0.1%
14-Jul	0	-2	2	0	-2	-1	0	0	0	0	0	2	2	0	0	0	0	1	0.1%
15-Jul	0	0	3	0	-3	-3	0	0	0	0	0	3	3	0	0	0	0	3	0.2%
16-Jul	0	0	3	0	-3	-2	0	0	0	0	0	2	2	0	0	0	0	2	0.1%
17-Jul	0	0	2	0	-2	-2	0	0	3	0	0	0	0	0	0	0	0	1	0.1%
18-Jul	0	0	1	0	-1	-1	0	0	2	0	0	0	0	0	0	0	0	1	0.1%
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
20-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
21-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Total =	84	65	68	-23	0	273	71	106	170	182	122	106	179	163	56	151	113	1,886	
	4.5%	3.4%	3.6%	-1.2%	0.0%	14.5%	3.8%	5.6%	9.0%	9.7%	6.5%	5.6%	9.5%	8.6%	3.0%	8.0%	6.0%	100.0%	

Table 5. Expanded daily hourly coho salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.

Shaded areas indicate hours not counted. Numbers in shaded areas indicate estimated passage.

Date	0000	0100	0200	0300	0400	0500-1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun							0	0	0	0	0	0	0	0	0	0	0	0	0.0%
18-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
19-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
20-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
21-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
22-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
23-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
24-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
25-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
26-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
27-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
28-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
29-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
30-Jun	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
1-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
2-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
3-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
4-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
5-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
6-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
7-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
8-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
9-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
10-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
11-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
12-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
13-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
14-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
15-Jul	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.0%
16-Jul	3	1	4	1	2		0	0	0	0	0	2	2	6	0	0	0	21	1.3%
17-Jul	5	2	8	2	3		0	3	3	6	0	3	3	12	0	0	0	50	3.2%
18-Jul	7	3	12	3	5		0	3	3	9	5	11	5	15	2	15	11	114	7.2%
19-Jul	9	3	15	3	6		18	3	3	12	9	21	6	6	18	3	30	186	11.7%
20-Jul	21	6	0	0	0		13	3	3	12	0	3	15	3	24	21	6	136	8.6%
21-Jul	12	3	0	2	3		19	3	3	8	6	2	11	6	12	24	15	194	12.2%
22-Jul	3	0	0	3	6		24	3	3	3	12	0	6	9	0	27	24	246	15.5%
23-Jul	33	15	6	9	0		46	9	0	0	15	9	117	66	33	42	39	472	29.8%
24-Jul	9	0	-3	0	0		16	3	12	12	9	6	9	63	6	9	6	166	10.5%
Total =	102	33	42	23	25		136	30	30	62	56	52	174	109	183	125	138	265	1,585
	6.4%	2.1%	2.6%	1.5%	1.6%		8.6%	1.9%	1.9%	3.9%	3.5%	3.3%	11.0%	6.9%	11.5%	7.9%	8.7%	16.7%	100.0%



Table 6. Expanded daily hourly Dolly Varden migration past the Shaktoolik River counting tower, Norton Sound, 1996.

Shaded areas indicate hours not counted. Numbers in shaded areas indicate estimated passage.

Date	0000	0100	0200	0300	0400	0500-1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun							0	0	0	-3	0	0	0	0	0	0	0	-3	5.6%
18-Jun	6	0	0	6	3	0	0	0	0	0	0	0	0	0	6	-3	0	18	-33.3%
19-Jun	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	-11.1%
20-Jun	-6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	-5.6%
21-Jun	0	3	-3	-3	0	0	0	0	0	0	-3	0	0	0	6	6	0	6	-11.1%
22-Jun	0	3	-3	0	0	0	0	0	0	0	0	0	0	0	-3	0	-3	-6	11.1%
23-Jun	0	2	-2	0	0	0	-2	0	0	0	0	0	0	-3	-2	0	-2	-9	16.7%
24-Jun	0	0	0	0	0	0	-3	0	0	0	0	0	0	-6	0	0	0	-9	16.7%
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6	-11.1%
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	-3	5.6%
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	3.7%
1-Jul	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	9	-16.7%
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	6	3	-5.6%
3-Jul	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	-11.1%
4-Jul	0	3	0	0	0	0	-3	0	0	0	0	0	0	0	2	0	0	2	-3.7%
5-Jul	0	0	0	0	0	0	-6	0	0	0	0	0	0	0	3	0	0	-3	5.6%
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
7-Jul	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4	-7.4%
8-Jul	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	6	-11.1%
9-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
10-Jul	0	0	0	0	0	0	0	3	-3	0	0	0	0	0	0	0	0	0	0.0%
11-Jul	0	-2	0	0	0	0	0	2	-2	0	0	0	0	0	-2	0	-2	-6	11.1%
12-Jul	0	-2	0	0	0	-8	0	0	0	0	0	0	0	0	-3	0	-3	-16	29.6%
13-Jul	0	-3	0	0	0	-9	0	0	0	0	0	0	0	0	0	-6	0	-18	33.3%
14-Jul	2	-5	-2	0	0	-11	-3	0	0	0	0	0	0	0	0	-3	0	-22	40.7%
15-Jul	3	-6	-3	0	0	-12	-6	0	0	0	0	0	0	0	0	0	0	-24	44.4%
16-Jul	3	-5	-3	0	0	-3	0	0	0	0	0	2	0	0	0	0	0	-6	11.1%
17-Jul	2	-3	-2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0.0%
18-Jul	1	-2	-1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0.0%
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
20-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
21-Jul	3	0	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	1	-1.9%
22-Jul	6	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	3	-5.6%
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Total =	20	1	-14	3	3	-39	-23	5	-5	2	-3	7	0	-9	7	0	-9	-54	
	37.0%	1.9%	-25.9%	5.6%	5.6%	-72.2%	-42.6%	9.3%	-9.3%	3.7%	-5.6%	13.0%	0.0%	-16.7%	13.0%	0.0%	-16.7%	100.0%	

Table 7. Reported hourly chum salmon observations at the Shaktoolik River counting tower, Norton Sound, 1996

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun	Start of the counting season													0	0	3	0	0	0	0	3	3	0	0	9	0.0%
18-Jun	3	0	0	6	3									0	0	0	0	0	0	0	0	0	0	0	12	0.0%
19-Jun	0	0	0	0	0									0	9	0	0	0	3	0	-9	18	3	-6	18	0.1%
20-Jun	3	12	3	-3	9									-3	-3	0	0	3	3	3	33	12		12	84	0.3%
21-Jun	15	9	0	3	3									0	27	9	9	15	3	30	0	9	3	27	162	0.6%
22-Jun	9	12	3	15	3									0	0	0	0	0	0	0	0	6	0	3	51	0.2%
23-Jun																									0	0.0%
24-Jun	33	45	9	12	51	75	27	18	15	21	21	0		0	9		3	51	0	-3	51	6	15	30	489	1.7%
25-Jun	27	36	6	0	33									0	21	3	69	36	42	18	63	96	27	6	483	1.7%
26-Jun	36	24	81	12	0																				153	0.5%
27-Jun																									0	0.0%
28-Jun																		123	6	0	0	9	-3	0	135	0.5%
29-Jun	0	18	15	99	75									12	9	-12	15	21	15	21	6	72	15	0	381	1.3%
30-Jun																									0	0.0%
1-Jul	15	6	-12	6	-3	0	6	18	6	9	45	0	3	9	3	0	9	81	-3	9	21	48	36	21	333	1.2%
2-Jul	3	18	6	21	24									-3	27	9	6	6	9	24	36		63	132	381	1.3%
3-Jul	156	477	330	33	21									102	60	21	18	72	81	123	96	222	294	108	2,214	7.8%
4-Jul																									0	0.0%
5-Jul	288	249	114	33	12									33	45	75	15	72	69	12	15	96	189	105	1,422	5.0%
6-Jul	207	132	42	12	6									57	57	30	6	57	114	24	288	72	162	279	1,545	5.4%
7-Jul																									0	0.0%
8-Jul	189	102	57	0	9	0	0	6	6	3	0	0	81	102	78	90	36	117	219	273	522	3,021	4,416	3,576	12,903	45.4%
9-Jul	87	57	48	15	9									48	45	24	21	192	36	63	27	3	6	0	681	2.4%
10-Jul	6	-3	0	0	0									3	6	36	21	12	165	651	510	150	36	9	1,602	5.6%
11-Jul																									0	0.0%
12-Jul														6	0	9	0	0	0	9	3	0	0	3	30	0.1%
13-Jul	0	6	-27	0	9									21	6	18	6	3	9	12	18	0	6	3	90	0.3%
14-Jul																									0	0.0%
15-Jul	129	33	48	27	3	12	-6	3	3	0	-3	-6	0	3	15	99	123	93	111	159	105	162	168	66	1,347	4.7%
16-Jul	9	15	3	0	3									21	24	12									87	0.3%
17-Jul														18	12	24	12	9	6	12	27	24	15	12	171	0.6%
18-Jul																									0	0.0%
19-Jul	60	51	27	9	0									3	3	6	39	108	81	84	132	24	51	90	768	2.7%
20-Jul	96	66	3	0	0									0	3	15	45	27	75	93	195	126	39	12	795	2.8%
21-Jul																									0	0.0%
22-Jul	48	27	3	3	3	0	0	6	3	3	6	-3	0	18	3	0	33	18	42	39	18	222	147	246	885	3.1%
23-Jul	123	75	18	6	0									6	3	0	108	132	168	78	102	39	96	117	1,071	3.8%
24-Jul	18	12	0	6	9									0	0	0	3	0	3	0	0	6	18	27	102	0.4%
Total	1,560	1,479	777	315	282	87	27	51	33	36	69	-9	84	456	465	468	597	1,248	1,257	1,734	2,262	4,446	5,802	4,878	28,404	
	5.5%	5.2%	2.7%	1.1%	1.0%	0.3%	0.1%	0.2%	0.1%	0.1%	0.2%	0.0%	0.3%	1.6%	1.6%	1.6%	2.1%	4.4%	4.4%	6.1%	8.0%	15.7%	20.4%	17.2%	100.0%	

Table 8. Reported hourly pink salmon observations at the Shaktoolik River counting tower, Norton Sound, 1996

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total
17-Jun	Start of the counting season												0	0	-3	0	0	0	0	0	0	0	-3	3	-3	0.0%
18-Jun	3	6	0	24	9									0	0	0	0	0	0	0	0	3	0	0	45	0.0%
19-Jun	3	3	6	3	0									0	0	3	0	0	0	3	3	21	9	0	54	0.0%
20-Jun	-3	18	3	6	-15									-3	0	0	0	6	3	0	-6	3		-12	0	0.0%
21-Jun	0	6	0	9	-6									0	0	0	0	6	0	12	0	-9	0	24	42	0.0%
22-Jun	-9	9	-6	-9	0									0	0	0	0	0	0	0	0	24	21	12	42	0.0%
23-Jun																									0	0.0%
24-Jun	24	12	3	0	24	36	6	0	0	0	0	0		6	3		12	27	9	6	114	9	33	24	348	0.1%
25-Jun	21	81	3	0	6									6	45	3	54	33	15	12	30	84	18	6	417	0.1%
26-Jun	21	30	33	0	9																				93	0.0%
27-Jun																									0	0.0%
28-Jun																		39	3	3	3	9	-6	0	51	0.0%
29-Jun	0	174	27	18	36									33	-6	3	0	27	3	12	15	96	21	0	459	0.1%
30-Jun																									0	0.0%
1-Jul	9	-3	3	15	15	-3	9	9	3	6	18	3	-3	12	0	9	0	60	-6	6	27	102	51	36	378	0.1%
2-Jul	12	60	27	27	15									3	9	75	96	60	114	51	96		60	174	879	0.2%
3-Jul	255	309	276	18	6									90	66	27	87	102	174	384	270	267	225	216	2,772	0.7%
4-Jul																									0	0.0%
5-Jul	477	447	126	48	27									519	552	306	264	183	441	87	72	168	1,023	2,061	6,801	1.6%
6-Jul	2,985	1,632	597	561	537									894	393	639	375	321	651	456	3,510	2,046	2,331	3,510	21,438	5.1%
7-Jul																									0	0.0%
8-Jul	7,431	3,093	1,626	45	291	720	429	564	294	183	120	36	162	120	111	90	36	117	417	1,551	5,658	26,103	18,987	13,686	81,870	19.6%
9-Jul	5,742	2,979	2,964	987	723									1,512	1,374	1,083	438	2,298	5,454	5,838	6,612	1,308	3,924	405	43,641	10.4%
10-Jul	420	210	39	6	18									150	309	1,092	684	627	19,077	61,290	47,175	4,206	2,586	1,599	139,488	33.4%
11-Jul																									0	0.0%
12-Jul														9	33	36	42	42	72	198	120	-9	60	-15	588	0.1%
13-Jul	-15	-93	-24	24	21									183	159	165	105	126	72	126	252	54	90	81	1,326	0.3%
14-Jul																									0	0.0%
15-Jul	1,578	210	180	117	81	51	81	21	15	24	0	12	24	42	48	273	585	699	1,239	1,392	1,611	2,481	2,289	1,083	14,136	3.4%
16-Jul	177	144	3	51	63									87	108	54									687	0.2%
17-Jul														96	381	471	405	369	306	327	813	996	801	636	5,601	1.3%
18-Jul																									0	0.0%
19-Jul	1,083	465	282	177	111									153	90	87	243	1,800	2,388	1,518	7,875	1,083	1,491	2,385	21,231	5.1%
20-Jul	1,923	1,848	141	36	27									324	372	756	3,795	1,887	3,927	3,351	5,100	3,558	1,278	600	28,923	6.9%
21-Jul																									0	0.0%
22-Jul	1,314	360	84	24	66	114	483	558	264	162	96	75	87	189	93	264	252	249	318	405	489	3,090	3,552	13,110	25,698	6.1%
23-Jul	1,509	669	294	51	6									90	78	102	1,191	2,721	3,072	1,554	804	1,827	2,481	1,806	18,255	4.4%
24-Jul	459	204	78	39	6									69	108	102	102	126	117	117	96	246	396	696	2,961	0.7%
Total	25,419	12,873	6,765	2,277	2,076	918	1,008	1,152	576	375	234	126	270	4,584	4,323	5,640	8,766	11,925	37,866	78,699	80,739	47,766	41,718	42,126	418,221	
	6.1%	3.1%	1.6%	0.5%	0.5%	0.2%	0.2%	0.3%	0.1%	0.1%	0.1%	0.0%	0.1%	1.1%	1.0%	1.3%	2.1%	2.9%	9.1%	18.8%	19.3%	11.4%	10.0%	10.1%	100.0%	

Table 9. Reported hourly king salmon observations at the Shaktoolik River counting tower, Norton Sound, 1996

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total						
17-Jun	Start of the counting season												0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0.2%				
18-Jun	0	0	0	0	0												0	0	0	0	0	0	0	0	0	0	0	0.0%				
19-Jun	0	0	0	0	0											0	0	0	18	0	0	0	0	0	0	0	0	18	1.3%			
20-Jun	0	6	0	0	3											9	9	21	51	48	45	36	39	6		3	276	20.2%				
21-Jun	3	0	0	0	0											3	18	24	6	15	9	15	3	0	0	0	96	7.0%				
22-Jun	0	0	3	0	0											0	0	0	0	0	0	0	0	0	0	0	3	0.2%				
23-Jun																										0	0.0%					
24-Jun	3	3	0	0	3	72	18	9	0	0	0	0		0	3		6	0	0	0	0	0	0	0	117	8.6%						
25-Jun	0	3	0	0	0											0	3	0	3	-3	3	3	-3	9	6	3	27	2.0%				
26-Jun	0	3	3	-3	0																					3	0.2%					
27-Jun																										0	0.0%					
28-Jun																								0	0	3	0	0	0	0	3	0.2%
29-Jun	0	0	0	0	0											0	3	9	0	0	0	0	0	6	3	3	24	1.8%				
30-Jun																										0	0.0%					
1-Jul	0	0	0	0	0	0	6	-3	3	0	0	0	15	18	18	12	36	9	18	21	45	6	75	21	300	21.9%						
2-Jul	3	3	6	0	0											24	12	12	6	6	-15	15	6	0	6	9	93	6.8%				
3-Jul	6	24	9	-6	0											9	0	15	15	12	9	9	6	0	-3	0	105	7.7%				
4-Jul																										0	0.0%					
5-Jul	0	3	6	0	0											0	9	15	0	0	3	12	0	3	6	6	63	4.6%				
6-Jul	33	3	0	0	0											0	6	9	0	6	6	0	0	0	6	27	96	7.0%				
7-Jul																										0	0.0%					
8-Jul	12	3	6	0	0	0	3	0	-3	0	3	0	6	0	0	3	0	0	0	15	0	-3	3	0	48	3.5%						
9-Jul	3	0	0	0	3											3	0	0	3	6	3	6	0	9	3	3	42	3.1%				
10-Jul	-3	0	3	-3	0											-6	0	0	6	6	0	3	27	9	0	6	48	3.5%				
11-Jul																										0	0.0%					
12-Jul														0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%		
13-Jul	0	-3	0	0	0											0	0	0	0	0	0	0	0	0	0	0	-3	-0.2%				
14-Jul																										0	0.0%					
15-Jul	0	0	3	0	-3	0	0	3	0	-3	0	0	-3	0	0	0	0	0	3	3	0	0	0	0	3	0.2%						
16-Jul	0	0	0	0	0											0	0	0									0	0.0%				
17-Jul														0	0	3	0	0	0	0	0	0	0	0	0	0	3	0.2%				
18-Jul																										0	0.0%					
19-Jul	0	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
20-Jul	0	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
21-Jul																										0	0.0%					
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%						
23-Jul	0	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
24-Jul	0	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
Total	60	48	39	-12	6	72	27	9	0	-3	3	0	18	60	81	126	150	105	84	141	123	45	105	81	1,368							
	4.4%	3.5%	2.9%	-0.9%	0.4%	5.3%	2.0%	0.7%	0.0%	-0.2%	0.2%	0.0%	1.3%	4.4%	5.9%	9.2%	11.0%	7.7%	6.1%	10.3%	9.0%	3.3%	7.7%	5.9%	100.0%							

Table 10. Reported hourly coho salmon observations at the Shaktoolik River counting tower, Norton Sound, 1996

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total					
17-Jun	Start of the counting season												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
18-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
19-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
20-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
21-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
22-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
23-Jun																										0	0.0%				
24-Jun	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0	0	0	0.0%				
25-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
26-Jun	0	0	0	0	0																					0	0.0%				
27-Jun																										0	0.0%				
28-Jun																		0	0	0	0	0	0	0	0	0	0.0%				
29-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
30-Jun																										0	0.0%				
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
2-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0			0	0	0	0.0%				
3-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
4-Jul																										0	0.0%				
5-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
6-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
7-Jul																										0	0.0%				
8-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
9-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
10-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
11-Jul																										0	0.0%				
12-Jul														0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
13-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
14-Jul																										0	0.0%				
15-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%				
16-Jul	0	0	0	0	0									0	0	0										0	0.0%				
17-Jul														3	3	6	0	0	3	3	12	0	0	0	0	30	2.6%				
18-Jul																										0	0.0%				
19-Jul	9	3	15	3	6									3	3	12	9	21	6	6	18	3	30	21	168	14.7%					
20-Jul	21	6	0	0	0									3	3	12	0	3	15	3	24	21	6	6	123	10.8%					
21-Jul																										0	0.0%				
22-Jul	3	0	0	3	6	3	3	9	0	6	0	-3	6	3	3	3	12	0	6	9	0	27	24	123	246	21.5%					
23-Jul	33	15	6	9	0									9	0	0	15	9	117	66	33	42	39	33	426	37.3%					
24-Jul	9	0	-3	0	0									3	12	12	9	6	9	9	63	6	9	6	150	13.1%					
Total	75	24	18	15	12	3	3	9	0	6	0	-3	6	24	24	45	45	39	156	96	150	99	108	189	1,143						
	6.6%	2.1%	1.6%	1.3%	1.0%	0.3%	0.3%	0.8%	0.0%	0.5%	0.0%	-0.3%	0.5%	2.1%	2.1%	3.9%	3.9%	3.4%	13.6%	8.4%	13.1%	8.7%	9.4%	16.5%	100.0%						

Table 11. Reported hourly Dolly Varden observations at the Shaktoolik River counting tower, Norton Sound, 1996

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total	% of Total		
17-Jun	Start of the counting season												0	0	0	0	-3	0	0	0	0	0	0	0	0	0	-3	-25.0%
18-Jun	6	0	0	6	3									0	0	0	0	0	0	0	0	6	-3	0	18	150.0%		
19-Jun	0	6	0	0	0									0	0	0	0	0	0	0	0	0	0	0	6	50.0%		
20-Jun	-6	6	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
21-Jun	0	3	-3	-3	0									0	0	0	0	-3	0	0	0	6	6	0	6	50.0%		
22-Jun	0	3	-3	0	0									0	0	0	0	0	0	0	0	-3	0	-3	-6	-50.0%		
23-Jun																									0	0.0%		
24-Jun	0	0	0	0	0	0	0	0	0	0	0	0		-3	0		0	0	0	0	-6	0	0	0	-9	-75.0%		
25-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	6	0	6	50.0%		
26-Jun	0	0	0	0	0																				0	0.0%		
27-Jun																									0	0.0%		
28-Jun																		0	0	0	0	0	0	0	0	0	0.0%	
29-Jun	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	-3	-3	-25.0%		
30-Jun																									0	0.0%		
1-Jul	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	75.0%	
2-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	-3	6	3	3	25.0%		
3-Jul	0	6	0	0	0									0	0	0	0	0	0	0	0	0	0	0	6	50.0%		
4-Jul																									0	0.0%		
5-Jul	0	0	0	0	0									-6	0	0	0	0	0	0	0	3	0	0	-3	-25.0%		
6-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
7-Jul																									0	0.0%		
8-Jul	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	6	50.0%		
9-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
10-Jul	0	0	0	0	0									0	3	-3	0	0	0	0	0	0	0	0	0	0	0.0%	
11-Jul																									0	0.0%		
12-Jul														0	0	0	0	0	0	0	0	-3	0	-3	-6	-50.0%		
13-Jul	0	-3	0	0	0									0	0	0	0	0	0	0	0	0	-6	0	-9	-75.0%		
14-Jul																									0	0.0%		
15-Jul	3	-6	-3	0	0	-6	0	0	0	-6	0	0	0	-6	0	0	0	0	0	0	0	0	0	0	-24	-200.0%		
16-Jul	9	0	0	0	0									0	0	0									9	75.0%		
17-Jul														0	0	0	0	0	3	0	0	0	0	0	3	25.0%		
18-Jul																									0	0.0%		
19-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
20-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
21-Jul																									0	0.0%		
22-Jul	6	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	25.0%		
23-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
24-Jul	0	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
Total	18	15	-6	3	3	-6	-3	0	0	0	3	0	0	-15	3	-3	0	-3	3	0	-6	9	0	-3	12			
	150.0%	125.0%	-50.0%	25.0%	25.0%	-50.0%	-25.0%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%	-125.0%	25.0%	-25.0%	0.0%	-25.0%	25.0%	0.0%	-50.0%	75.0%	0.0%	-25.0%	100.0%			

Table 12. Shaktoolik River counting tower climatological and stream observations, Norton Sound 1996.

Date	Water Temperature °C	Water Depth "
17-Jun	13	
18-Jun	12	
19-Jun	11	
20-Jun	12	
21-Jun	12	
22-Jun	12	
23-Jun		
24-Jun	14	
25-Jun	14	2
26-Jun	11	13
27-Jun		3
28-Jun	11	3
29-Jun	11	1
30-Jun		
1-Jul	9	0
2-Jul	9	-2
3-Jul	10	-4
4-Jul		
5-Jul	13	-6
6-Jul	14	-1
7-Jul		
8-Jul	14	-3
9-Jul	14	-3.5
10-Jul	13	-3.5
11-Jul		
12-Jul	12	1.5
13-Jul	13	-1
14-Jul		
15-Jul	13	-1
16-Jul	12	-1.5
17-Jul	13	-1
18-Jul		
19-Jul	9	-3.5
20-Jul	9	-3.5
21-Jul		
22-Jul	12	-4
23-Jul	12	-3.5
24-Jul	13	-3

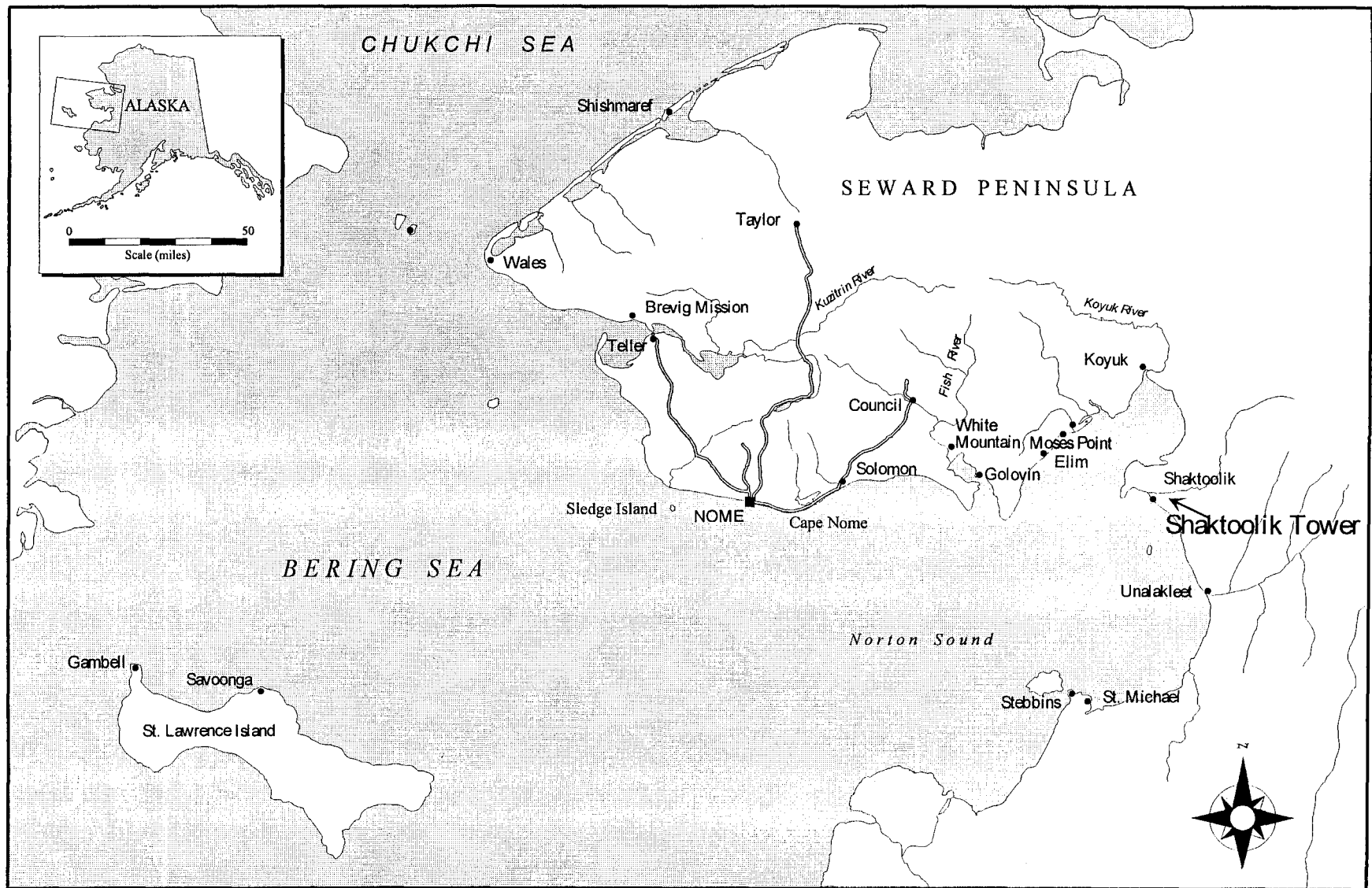
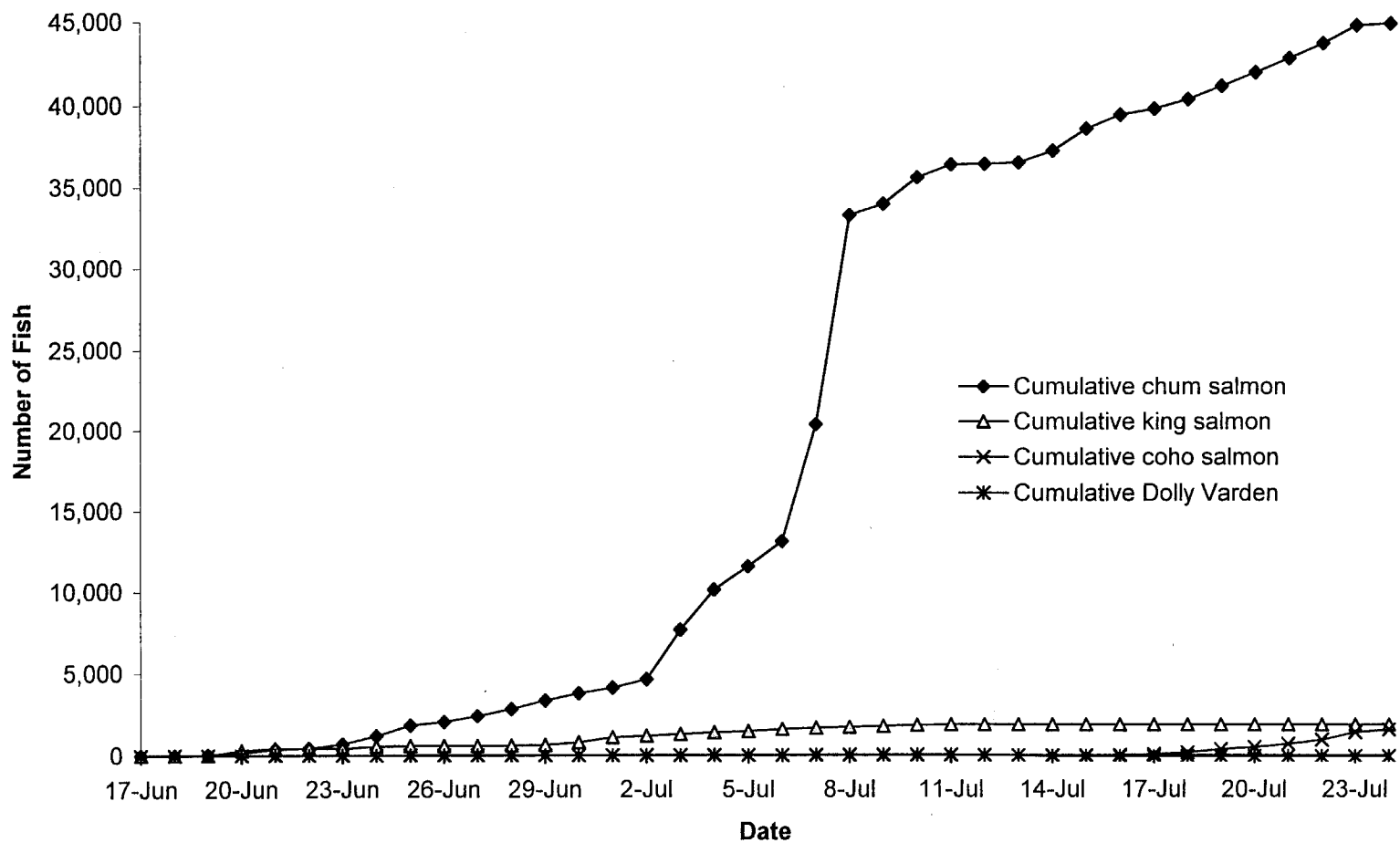


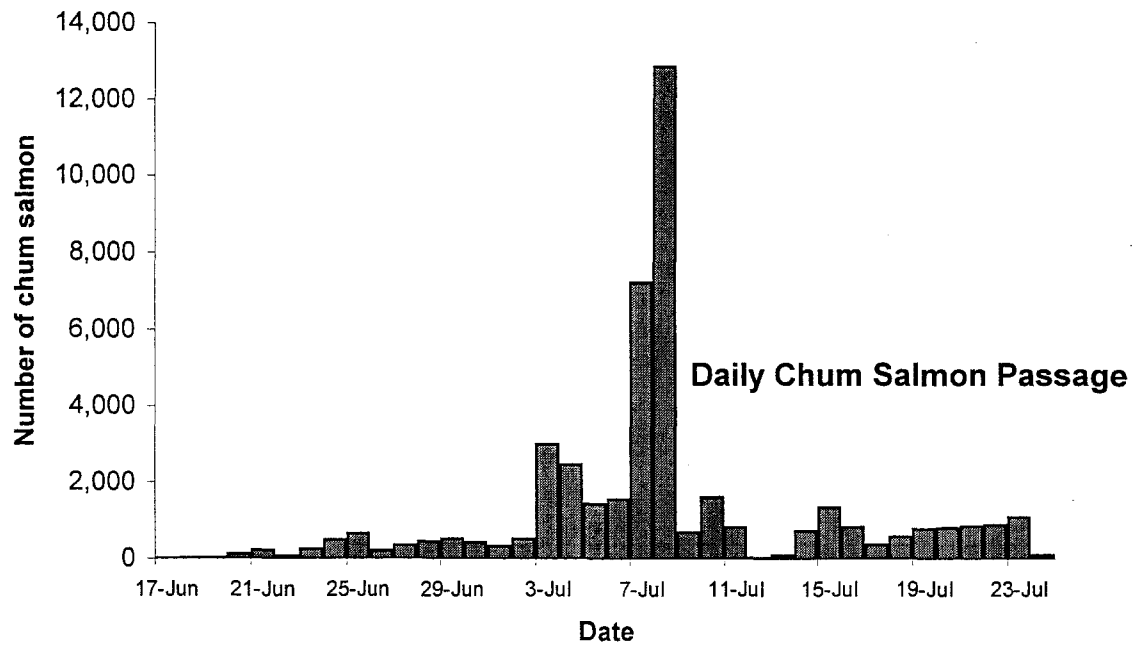
Figure 1. Area location map of the Shaktolik River counting tower project site, Norton Sound, 1996.



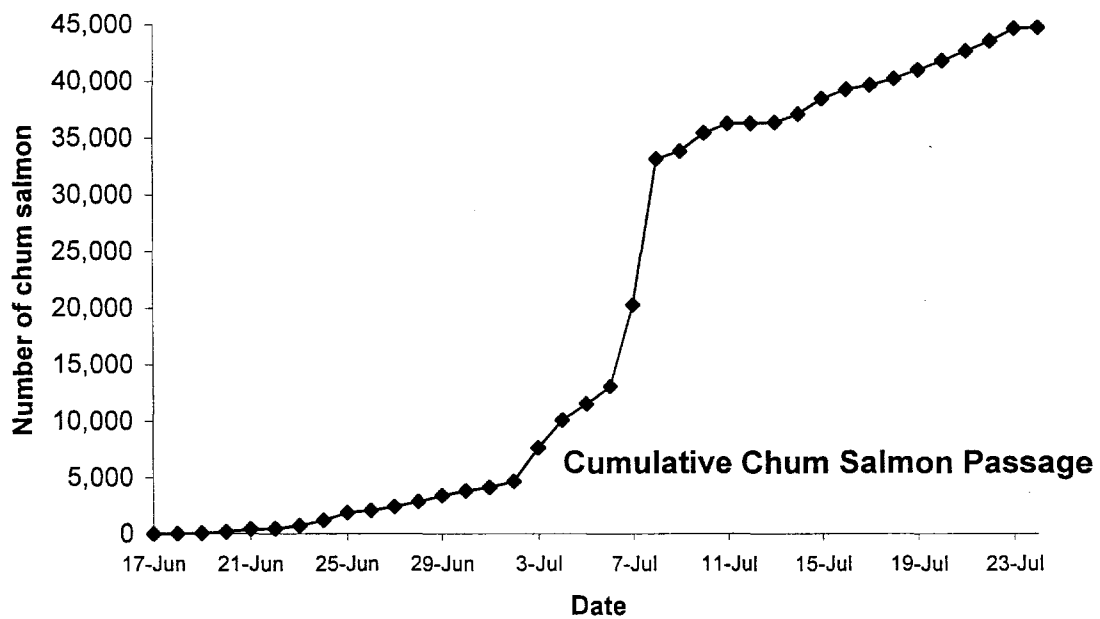
**Figure 2. Shaktoolik River counting tower cumulative passage of all salmonid species, except pink salmon, Norton Sound, 1996.**



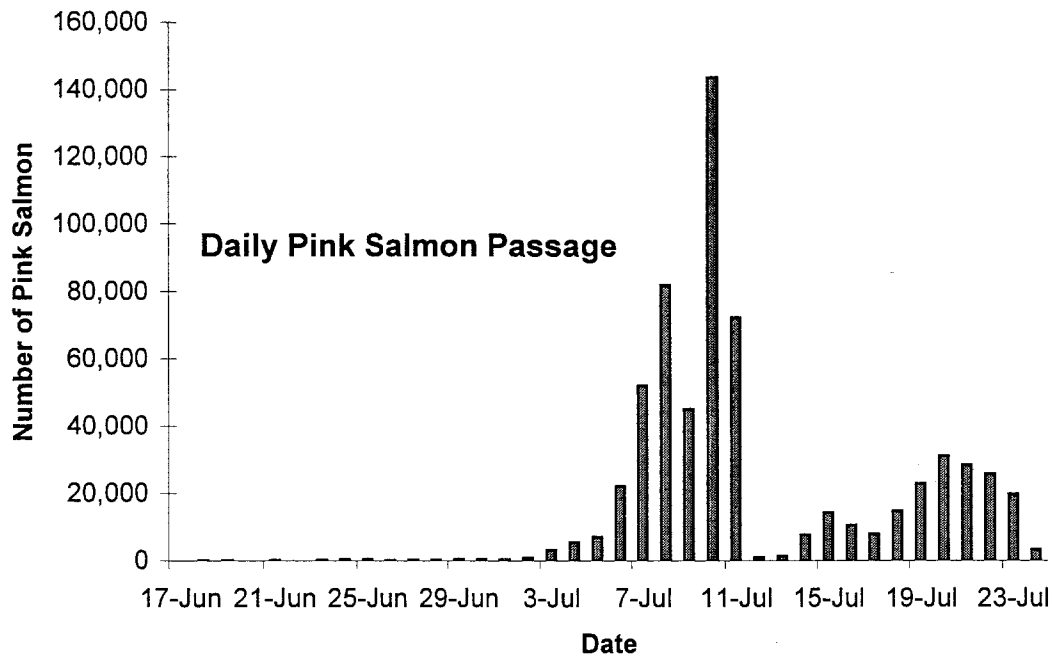
**Figure 3. Daily chum salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



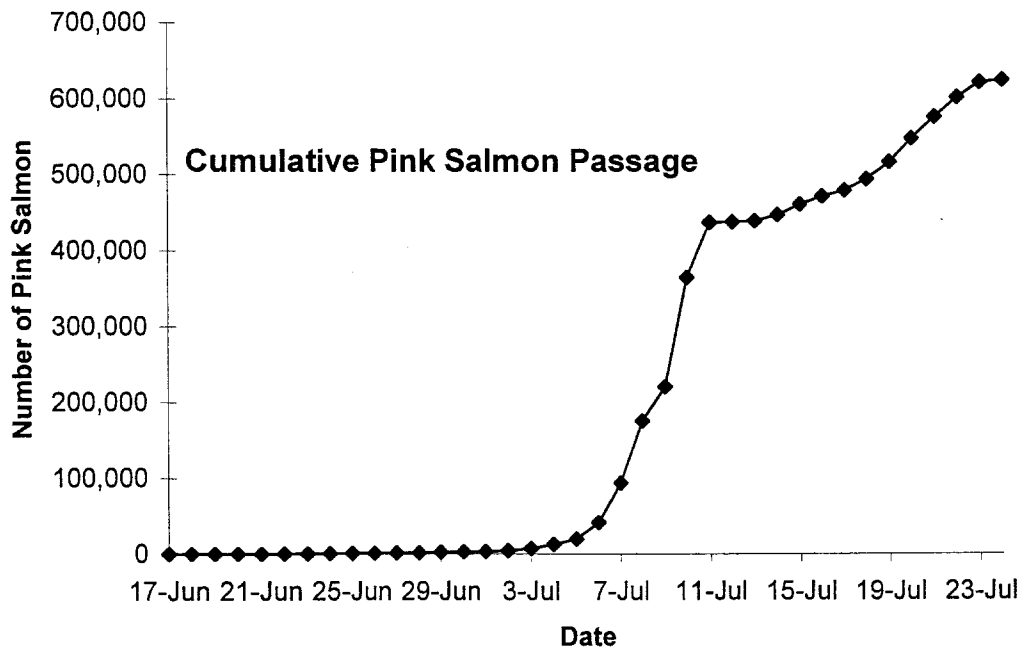
**Figure 4. Cumulative chum salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



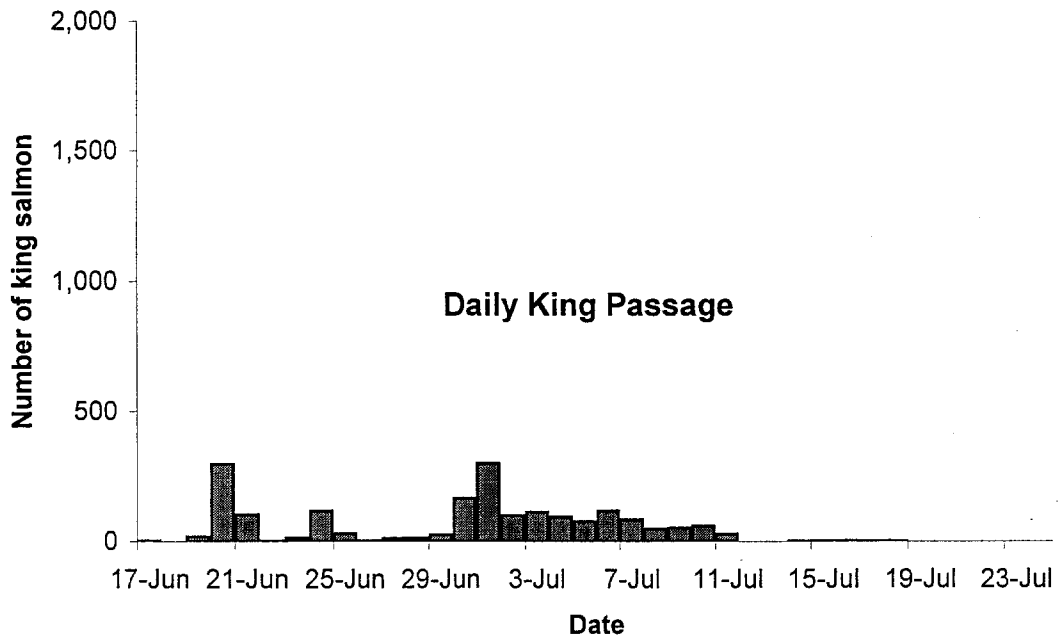
**Figure 5. Daily pink salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



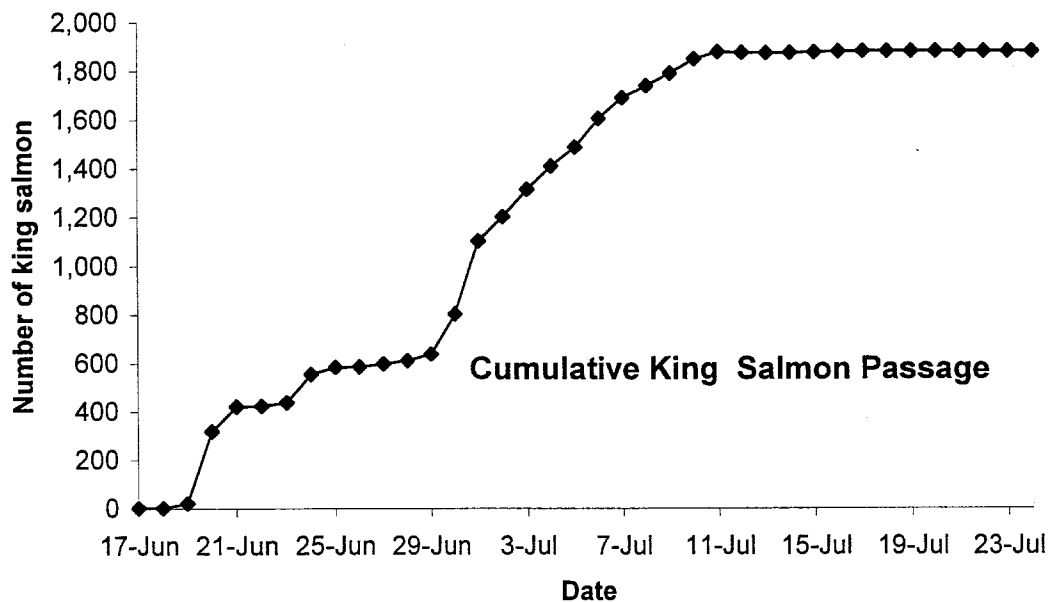
**Figure 6. Cumulative pink salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



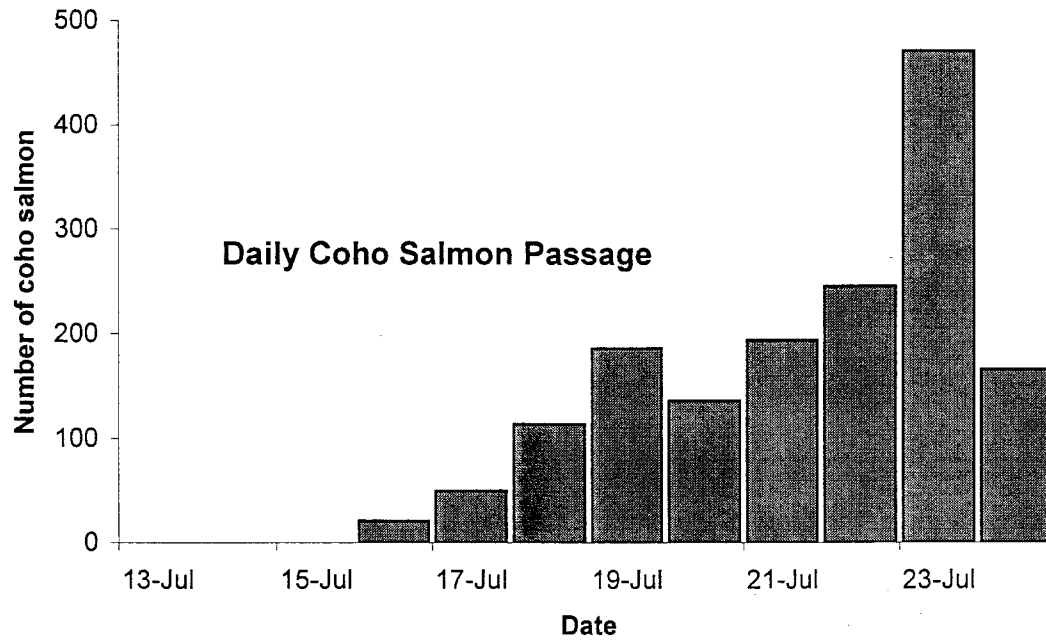
**Figure 7. Daily king salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



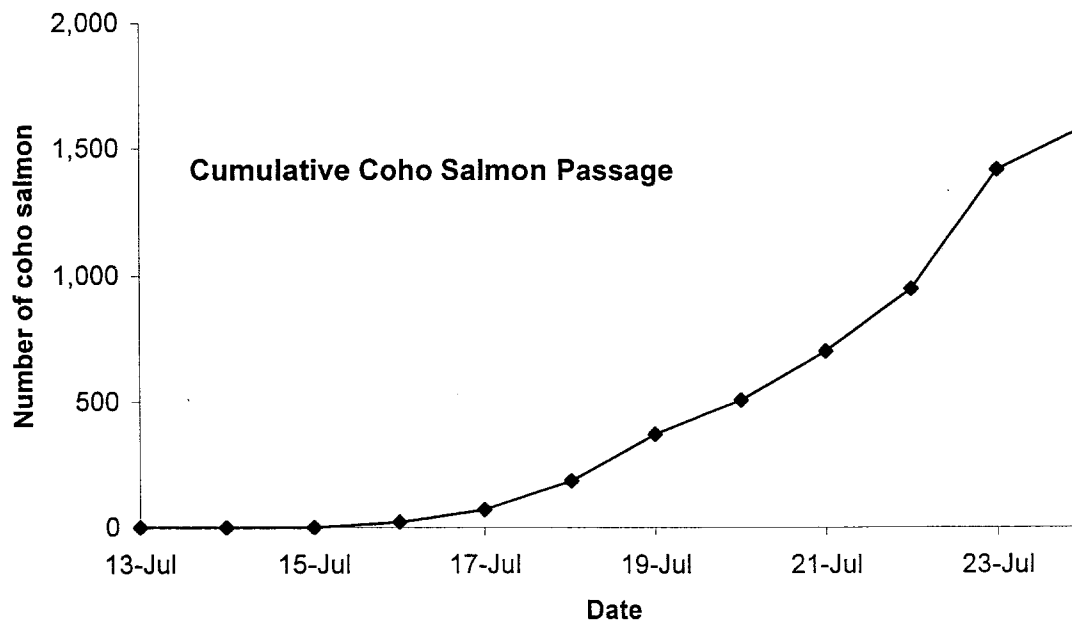
**Figure 8. Cumulative king salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



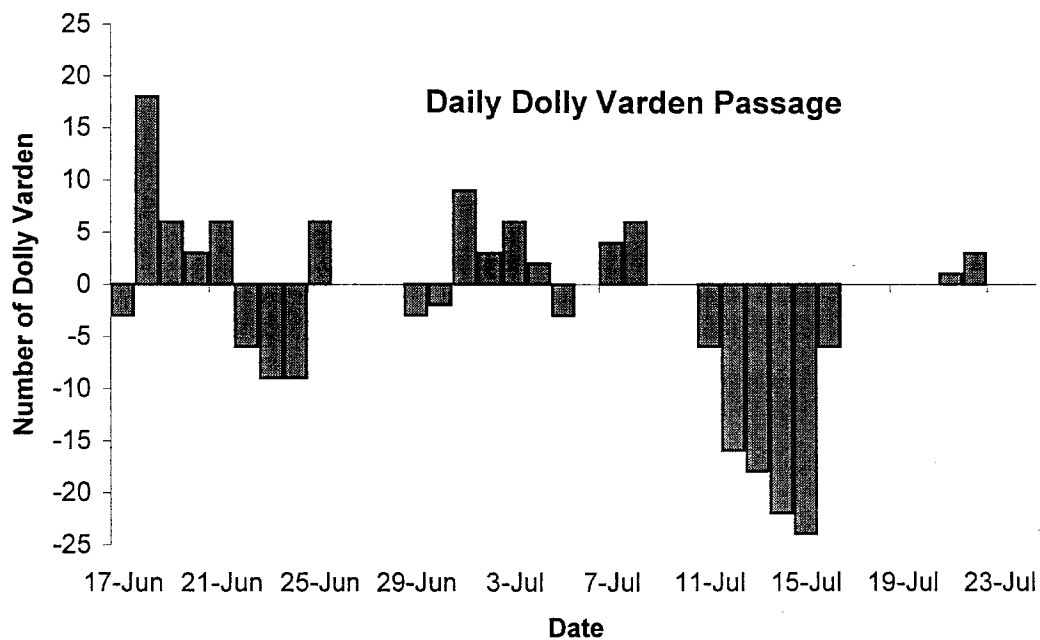
**Figure 9. Daily coho salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



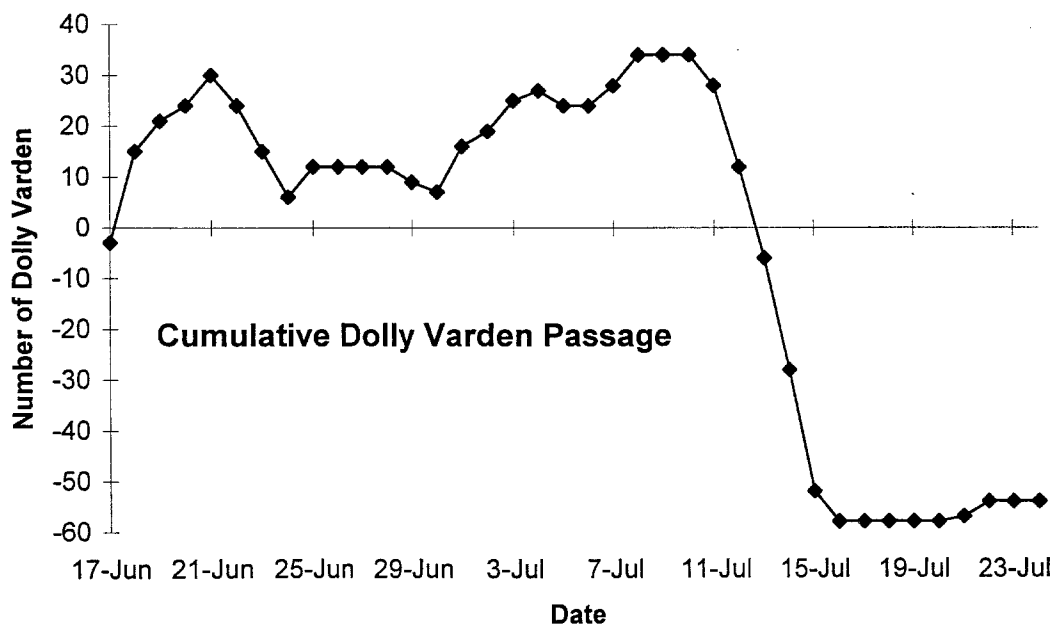
**Figure 10. Cumulative coho salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



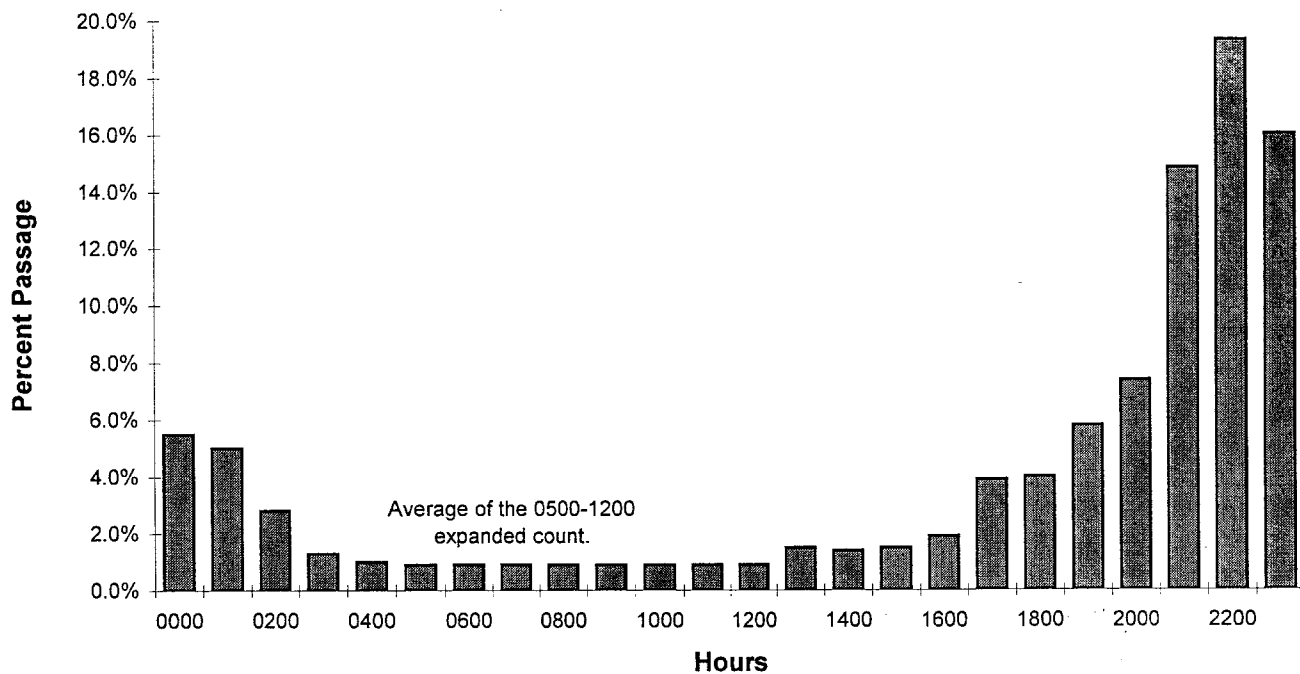
**Figure 11. Daily Dolly Varden migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



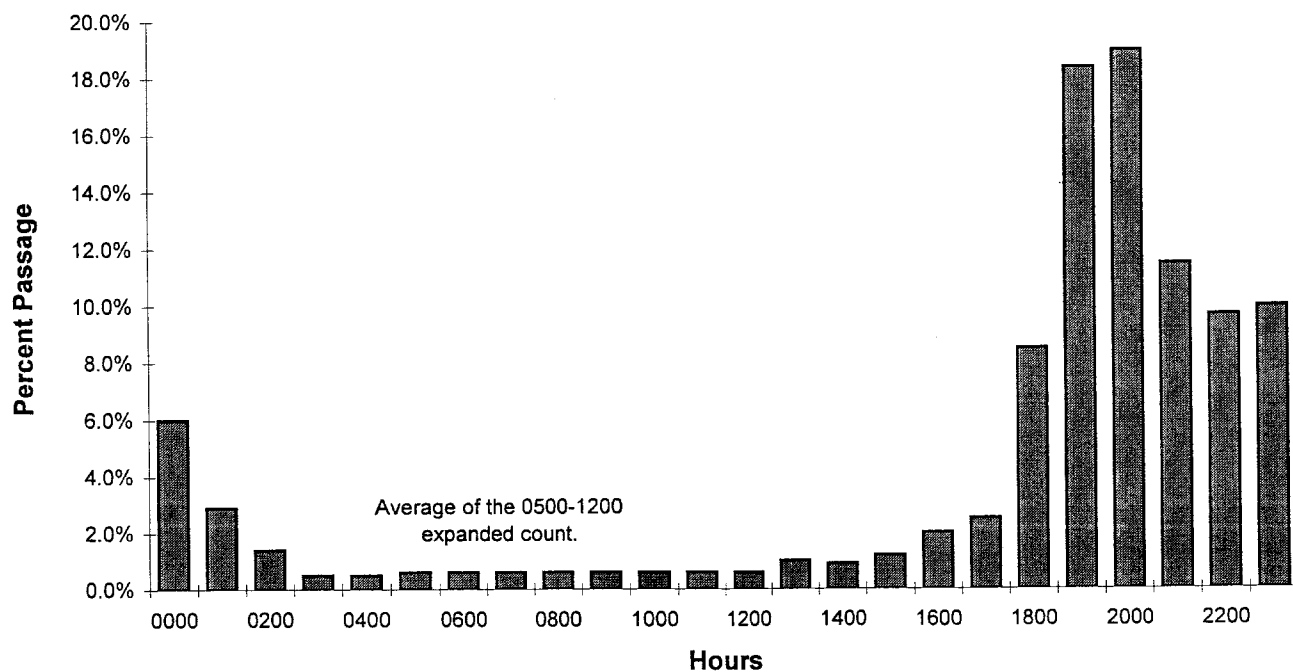
**Figure 12. Cumulative Dolly Varden migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



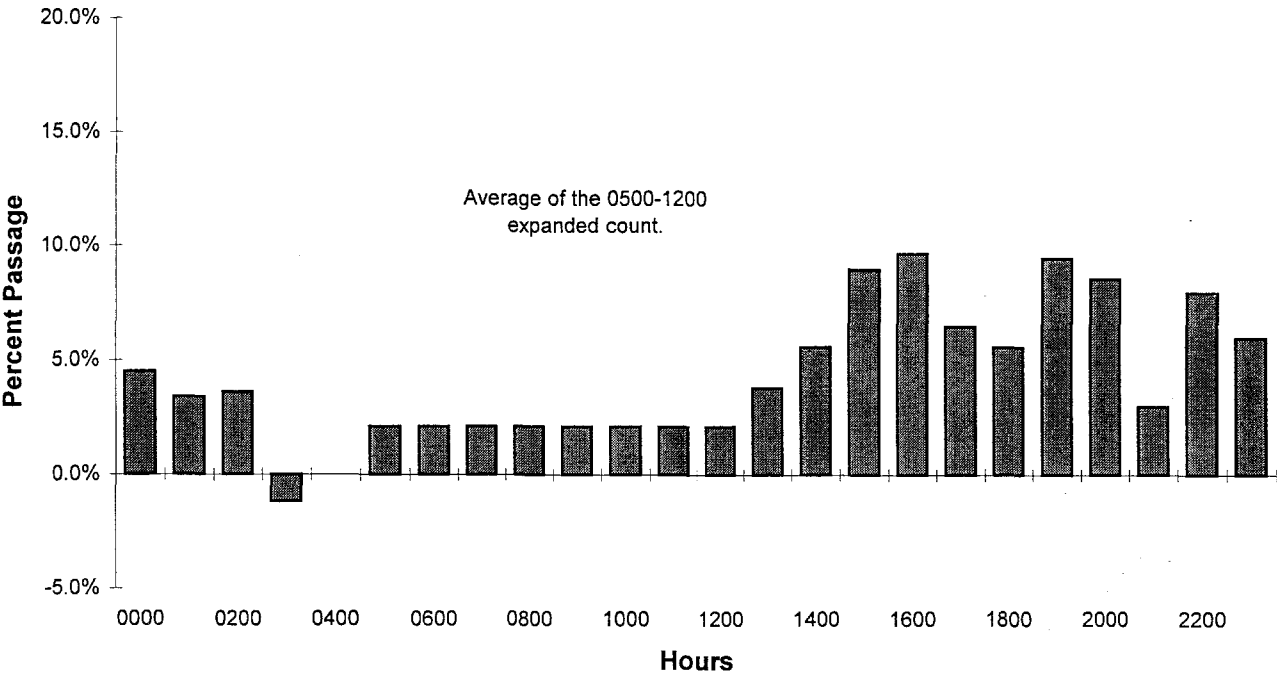
**Figure 13. Diurnal pattern of chum salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



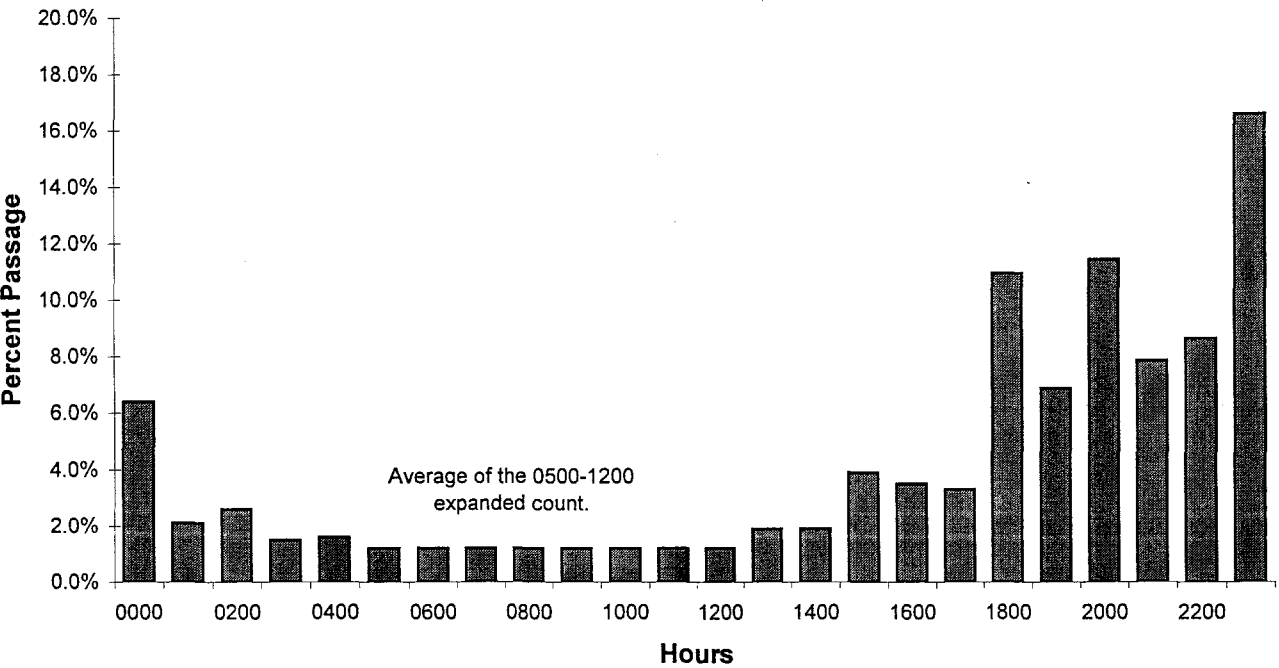
**Figure 14. Diurnal pattern of pink salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



**Figure 15. Diurnal pattern of king salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**



**Figure 16. Diurnal pattern of coho salmon migration past the Shaktoolik River counting tower, Norton Sound, 1996.**





**Figure 17. Diurnal pattern of Dolly Varden migration past the Shaktoolik River counting tower, Norton Sound, 1996.**

